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SN 10/776,919

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An agency of Industry Canada

CA 2305860 A1 2001/10/20

(21) 2 305 860

(12) DEMANDE DE BREVET CANADIEN
CANADIAN PATENT APPLICATION

(13) A1

(22) Date de dépôt/Filing Date: 2000/04/20

(41) Mise à la disp. pub./Open to Public Insp.: 2001/10/20

(51) Cl.Int.^{7}/Int.Cl.^{7} H01Q 1/32, G01S 5/14

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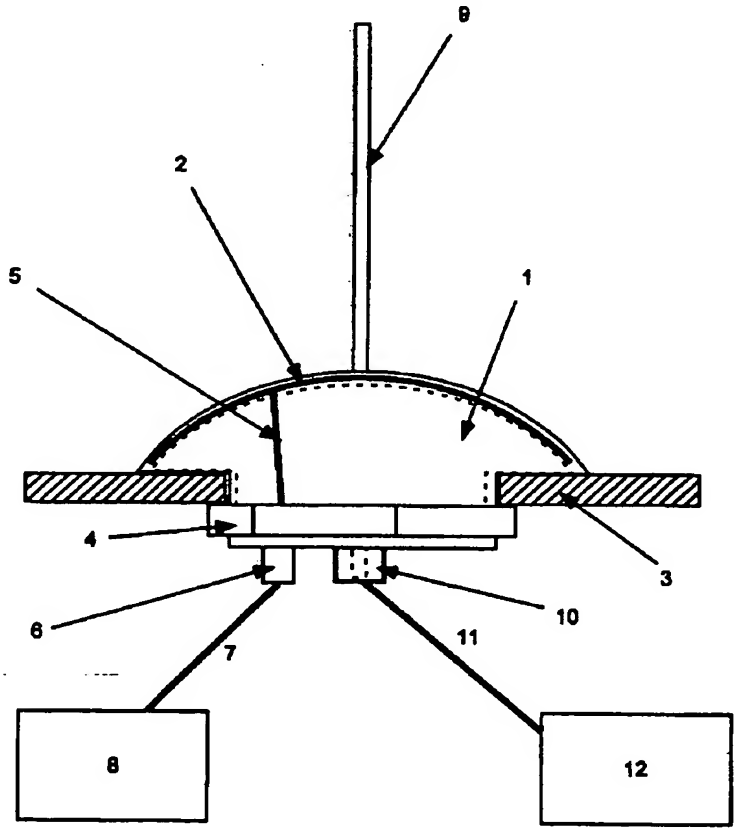
(54) Titre : ANTENNE RADIO D'AUTOMOBILE A ELEMENT GPS INTEGRE

(54) Title: CAR RADIO ANTENNA WITH INTEGRATED GPS MEANS



Car radio antenna with integrated GPS means

DESCRIPTION OF THE INVENTION

Figure 1 is a cross sectional view showing the present invention installed through the bodywork of a car. Mounting base 1 is hollow with an exposed upper portion and a threaded lower portion that penetrates car body wall 3 and secured thereto with mounting bolt 4.

The exposed upper portion of mounting base 1 is formed to closely resemble a conventional AM/FM car radio antenna-mounting base. Typically, the upper exposed portion is approximately 1 to 2 inches in diameter and may extend upwards an inch or more.

Figure 1 illustrates a domed mounting base 1 however it may also be disk shaped, cylinder shaped, cone shaped or combinations thereof. Also not illustrated is a mounting base that is shaped to resemble the popular "roof pillar" style of antenna mount. The roof pillar style of mounting base is asymmetrical in shape and flush-mounted into a roof pillar near the car's roofline. A roof pillar mounting base presents approximately the same exposed surface area as the illustrated mounting base 1 and is therefore also adaptable to all embodiments of the present invention.

The lower portion of mounting base 1 is typically a threaded cylinder sized to fit through a hole in car body 3. Typical mounting holes are approximately 0.75 inch in diameter however any size or shape of mounting hole may be accommodated by appropriate shaping of mounting base 1. Threaded retention bolt 4 affixes mounting base 1 to car body 3. While direct threaded retention means are illustrated, various other retention means will be obvious to those practiced in the art (spring-clips, pinch-bolts etc.).

GPS antenna 2 is bonded immediately below the upper surface of mounting base 1. GPS antenna 2 may be a "Microstrip patch" style of membrane antenna or a simpler "Crossed conductor" style of antenna. If the shape of mounting base 1 is more cylindrical than illustrated, then a "Quadrafilar helix" style of antenna winding may also be used. Mounting base 1 is made of a molded plastic material that provides good r.f. transmission properties as well as

adequate electrical insulation of the antenna element, mechanical protection of the antenna element and visual similarity to that of typical car radio antenna mounting bases. Conductor 5 carries the GPS r.f. signal from GPS antenna 2 to a standard coax connector 5 located on the lower portion of mounting base 1. Coax cable 7 carries the GPS r.f. signal to GPS receiver 8 which is mounted elsewhere within the vehicle.

Whip antenna element 9 is a thin, conductive rod affixed through mounting base 1 and electrically isolated from GPS antenna 2. Whip antenna 9 may be a fixed length rod, a telescopic rod or a motorized retractable rod (not illustrated). Coax connector 10 terminates the lower end of whip antenna 9. Coax cable 11 carries the r.f. signal to a standard AM/FM car radio 12.

Unless GPS receiver 8 is located very close to mounting base 1, the GPS signal may be too attenuated to permit GPS receiver 8 to operate correctly. Therefore in another preferred embodiment illustrated in Figure 2, Low Noise Amplifier (LNA) 13 is provided within mounting base 1 in order to boost signal strength to an adequate level. Cable 7 is therefore configured to provide electrical power to LNA 13 as well as to conduct the amplified r.f. signal to GPS receiver 8

Referring to Figure 3: a more compact and simpler assembly is provided by locating GPS receiver chipset 14 within mounting base 1, thereby eliminating the need for LNA 13 as well as external GPS receiver 8. GPS chipset 14 must be miniaturized in order to fit within the limited space inside of mounting base 1. GPS chipset 14 uses signals from GPS antenna 2 to compute digital position data. Said data is output via serial connector 15 and conducted to computer/display unit 17 via data/power cable 16. Computer/display unit 17 is typically built into the dash of the car where it serves to relate digital map data to the changing location of the user's car.

Voice cell phone with integrated data modem 22 may also be connected to computer 17. Data link 22 may be used by algorithms running on computer 17 to automatically communicate the vehicle's position to third parties via long-

distance wireless data path 29, thereby enabling applications such as fleet tracking and stolen vehicle recovery.

GPS chipset 14 may be a moderately accurate "single point" receiver that relies solely on satellite signals to measure location. GPS chipset 14 may also provide internal means for operating in the more accurate "differential" mode using correction broadcasts from the "Wide Area Augmentation System" satellites. Differential corrections may also be received from terrestrial 300 KHz marine radiobeacons by means of ceramic filter 19. Ceramic filter 19 is a band pass filter that permits AM/FM frequencies to pass unimpeded to radio 12. However the 300 KHz frequencies received via whip antenna 9 are filtered and transmitted via conductor 19 to GPS chipset 14. Hardware on-board GPS chipset 14 decodes and applies the received RTCM SC-104 differential corrections. GPS chipset 14 may also include a CPU capable of controlling peripheral electronic modules.

It may be difficult to sufficiently miniaturize the electronic component modules in order to fit within the confined space of the upper portion of mounting base 1. Therefore, in a preferred embodiment illustrated by Figure 4, the electronic component modules are manufactured on elongated circuit boards that permit the bulk of the components to be housed within the lower portion of mounting base 1. To accommodate modules 14 and 18, the lower portion of mounting base 1 is extended axially below bodywork 3 of the car.

To accommodate larger electronic modules, the space within the lower portion of mounting base 1 may also be increased by extending the lower mounting base transversely below bodywork 3 (not illustrated). Providing this larger component housing requires that fixation means 4 be devised to mate the expanded housing to a detachable upper portion (also not illustrated).

To improve the present invention's user friendliness and cost-effectiveness, a handheld computer or Personal Digital Assistant (PDA) is used to display and add value to the positions output from mounting base 1. Furthermore, the display and control computer should be quickly and easily removable from the car. Therefore, in a preferred embodiment illustrated in

Figure 5, a short-range low-power wireless data link is used in place of the hard-wired serial data link described above (15, 16 and 17 in Figure 4). "Bluetooth" and "HomeRF" are two well-known standards for such wireless digital data communications. The term "Bluetooth" is hereafter used in this description to generically refer to such wireless data link capability.

To achieve the desired ease of use, Bluetooth data module 20 is located within mounting base 1 and connected to GPS chipset 14 via bus 21. A wireless r.f. data communications link 28 thereby exists between mounting base 1 and Bluetooth enabled PDA 23, whenever PDA 23 is within r.f. reception range (typically within several meters). PDA 23 is temporarily mounted within the car's cabin thereby permitting data to be transmitted to and from mounting base 1 through the car's windows. Typically, the user will carry the Bluetooth enabled PDA 23 throughout the day in order to use it for various personal scheduling and data retrieval tasks. When the user enters the car, he or she affixes PDA 23 to the dashboard using Velcro, magnets, spring-clips or the like. PDA 23 and Bluetooth module 20 then automatically establish a wireless data link thereby enabling display of GPS information. For example, while receiving valid GPS position data from mounting base 1, the PDA might display a digital roadmap and plot the car's trajectory over it (not illustrated).

Since data is broadcast directly between mounting base 1 and Bluetooth enabled PDA 23, data/power cable 16 is not required. Therefore, electrical power from the car's main battery is supplied to all active electronic components within mounting base 1 via power connector 24.

A principal object of the present invention is to provide a concealed GPS antenna that can act as part of a theft recovery system. Antenna concealment improves such a system's effectiveness because a thief cannot visually detect its presence and take action to disable it. With reference to Figure 6, cell phone radio and data modem unit 22 is housed within mounting base 1 and connected to whip antenna 9 by Y connector/tuning unit 27. Alternatively, radio unit 22 may be connected to a separate concealed cell phone antenna (not illustrated). Car theft alarm system 25 detects forced entry into the vehicle and signals mounting

base 1 via power cable/data cable 26. Firmware operating within mounting base 1 may then command broadcast of the vehicle's location to law enforcement office to aid in its recovery. For example, cell phone unit 22 could be programmed to dial 911 and then issue a synthesized voice message indicating that the vehicle has just been stolen and direct police to its current location. This same position reporting function may also be used for various other tracking applications. For example, fleet vehicles might automatically broadcast positions to a dispatcher.

PDA 23 may also use short-range wireless data path 28 to forward other information through long-range wireless data path 29 (e.g. to send and receive e-mail).

Despite its ordinary appearance, a thief suspecting that the car is protected by an alarm system capable of alerting police might try to disable mounting base 1 prior to stealing the car. For example, mounting base 1 could be covered with foil or hit with a hammer. To help prevent such detection and disabling by thieves, a decoy antenna may be affixed to the car (not illustrated). In contrast to mounting base 1 the decoy antenna is shaped to give the impression of a sophisticated GPS/cellular antenna. The decoy antenna is placed in an obvious location such that most thieves will elect to disable the decoy antenna and leave mounting base 1 untouched.

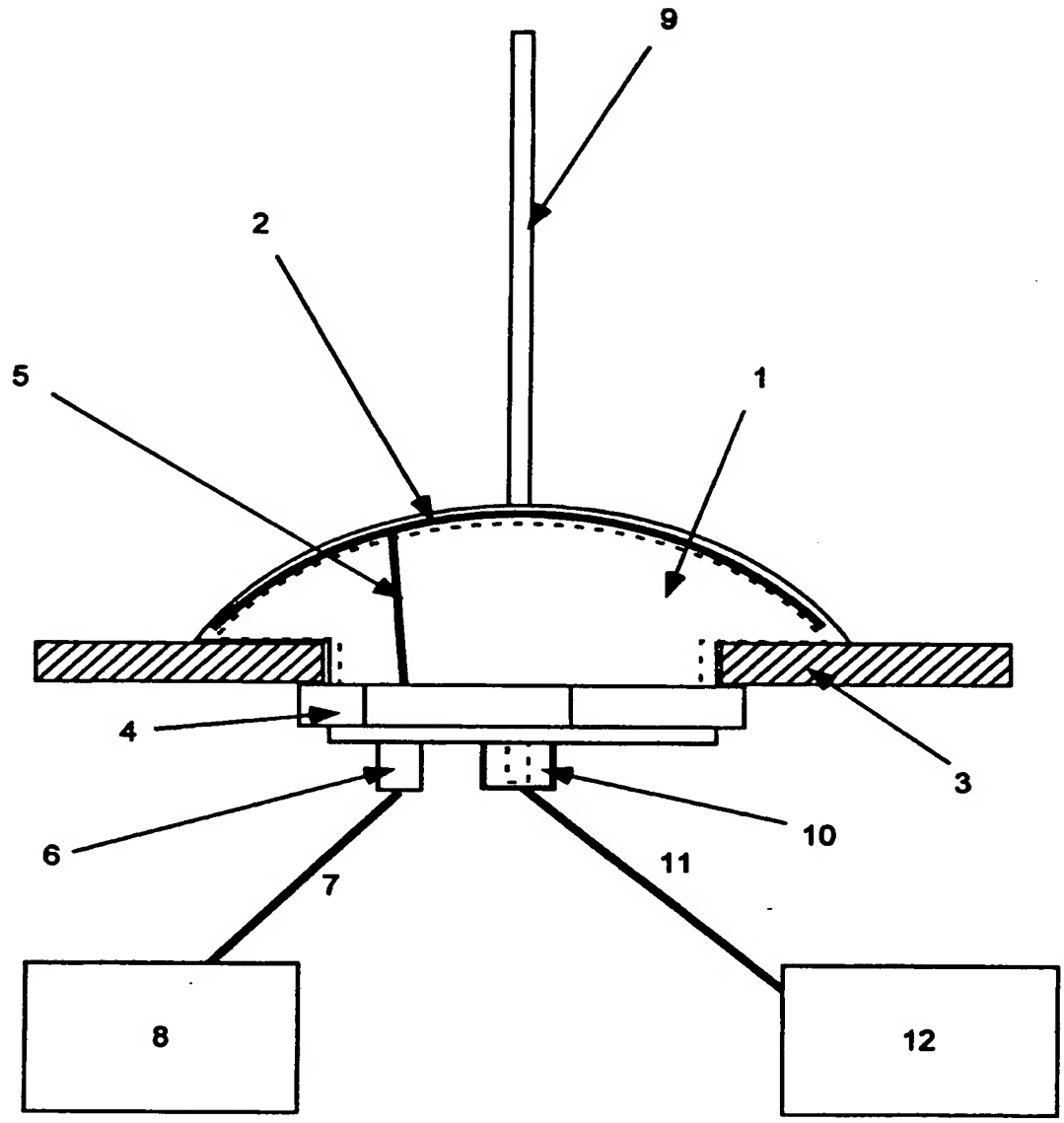


Figure 1

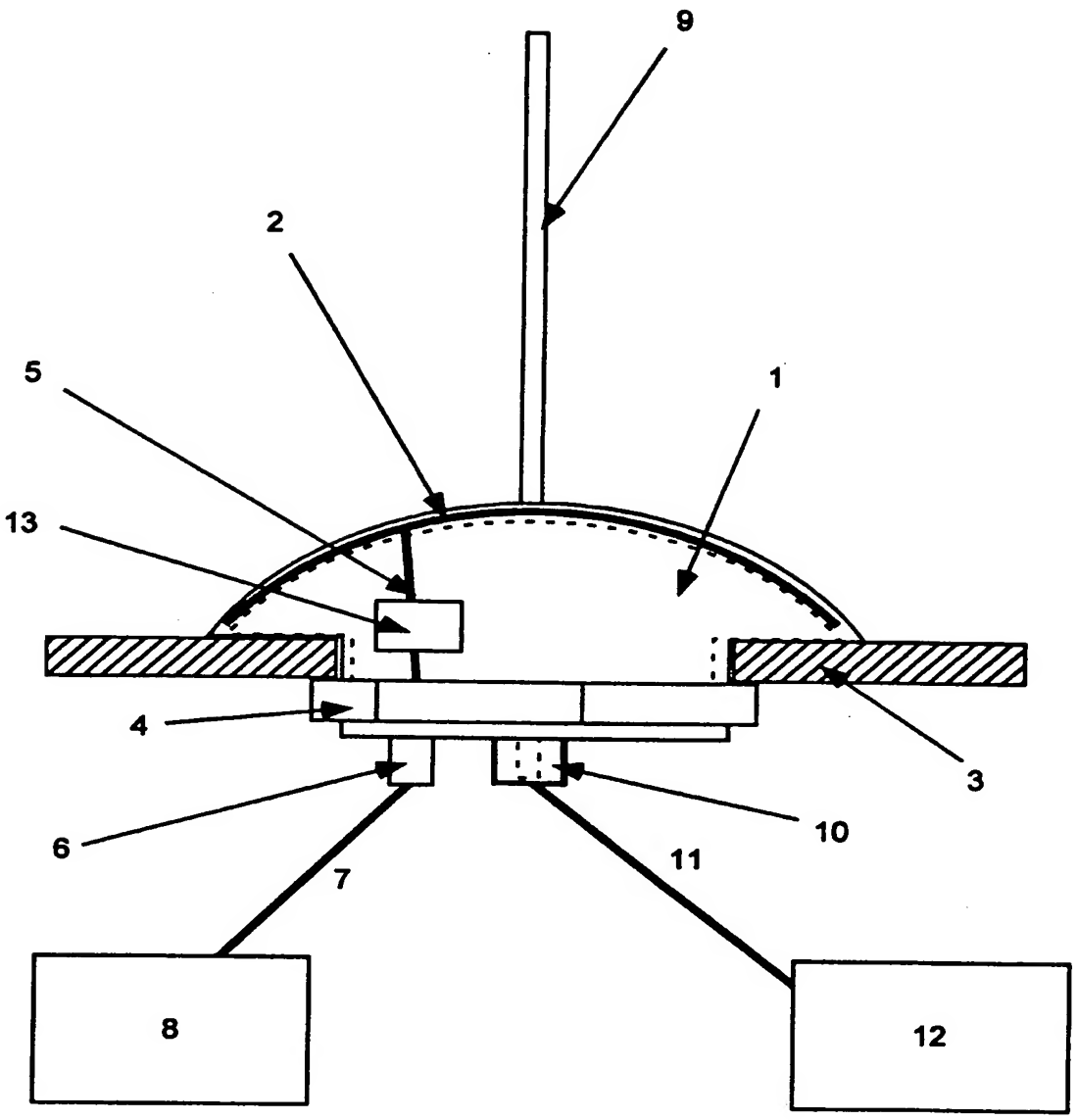


Figure 2

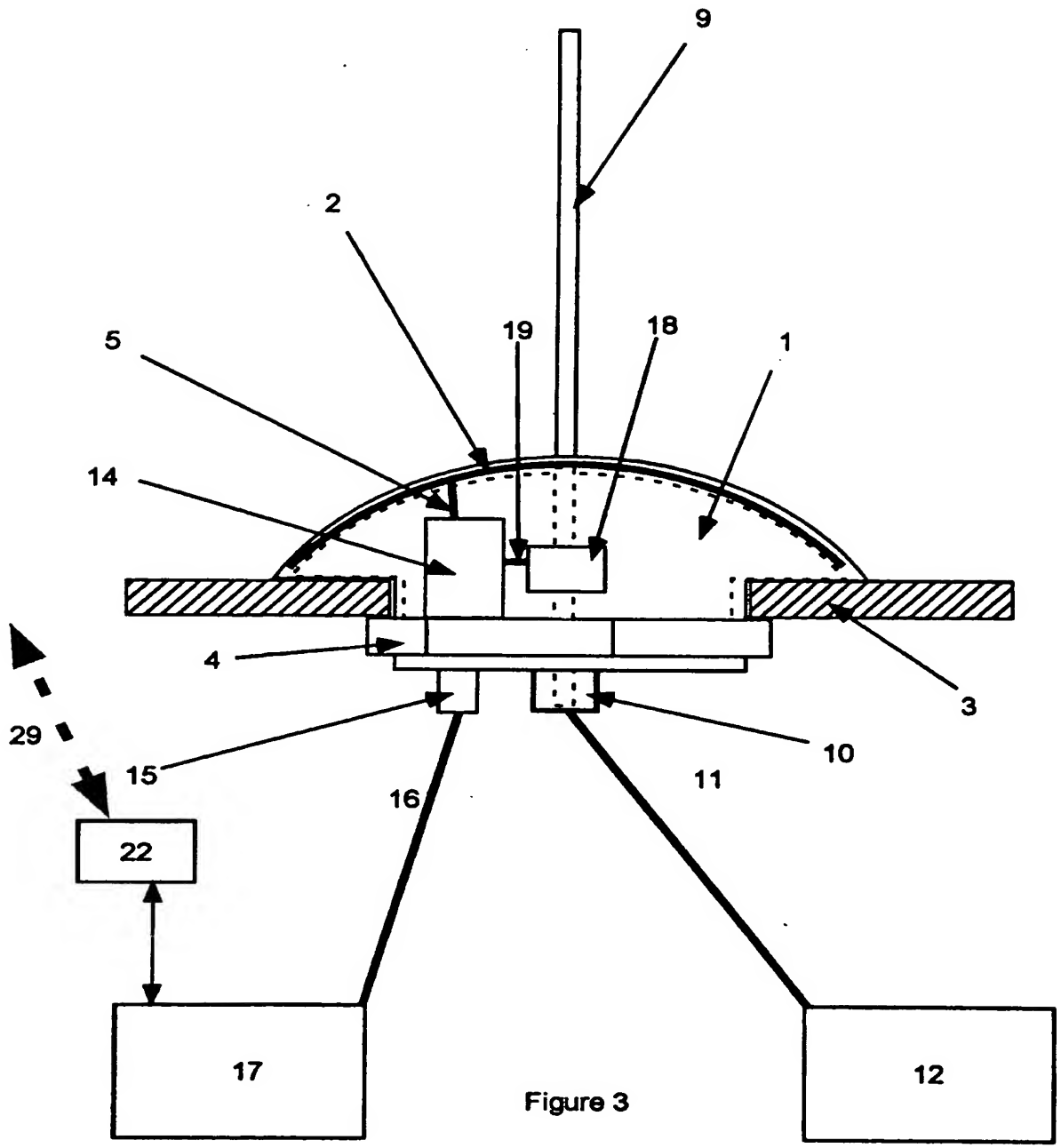


Figure 3

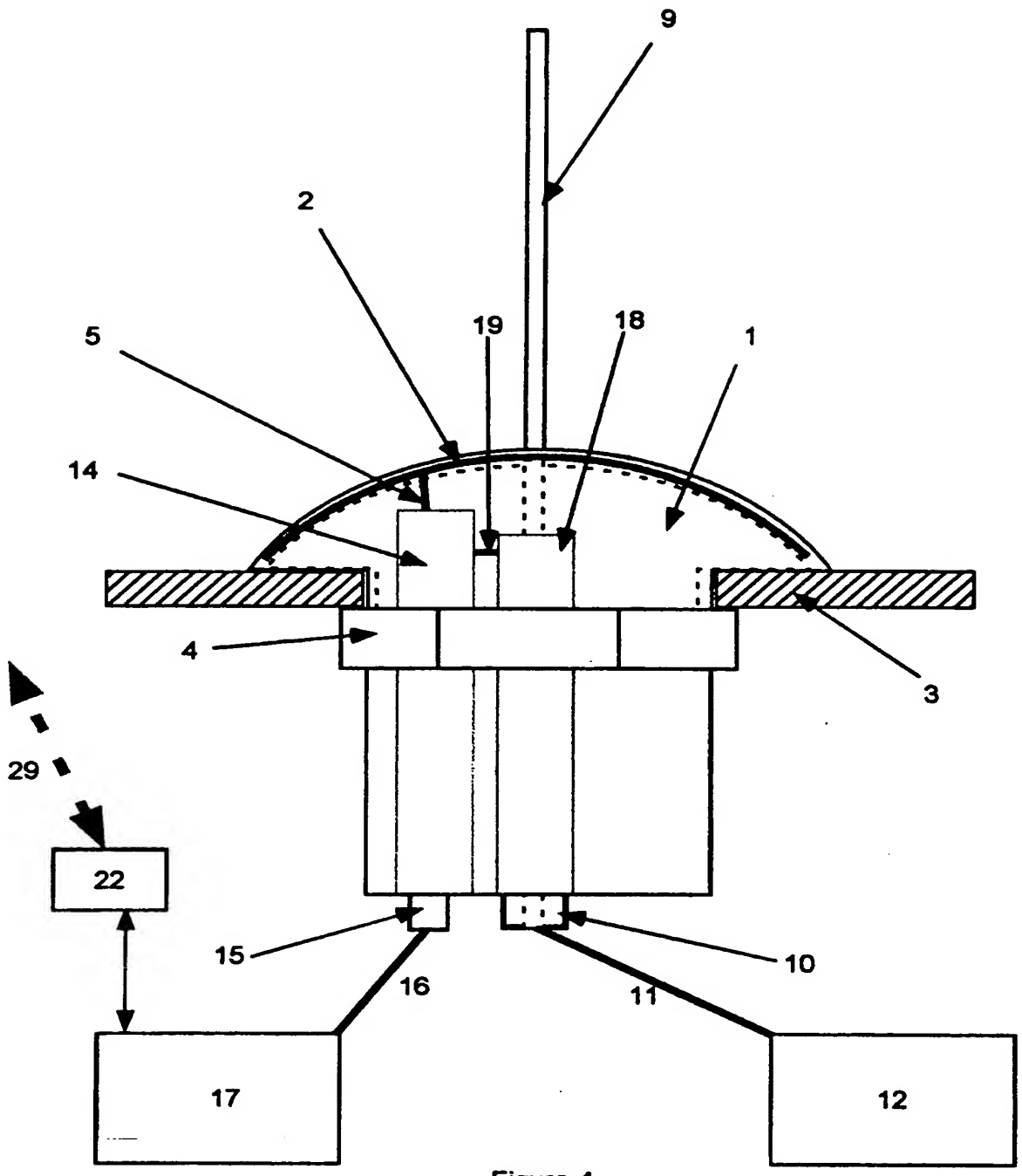


Figure 4

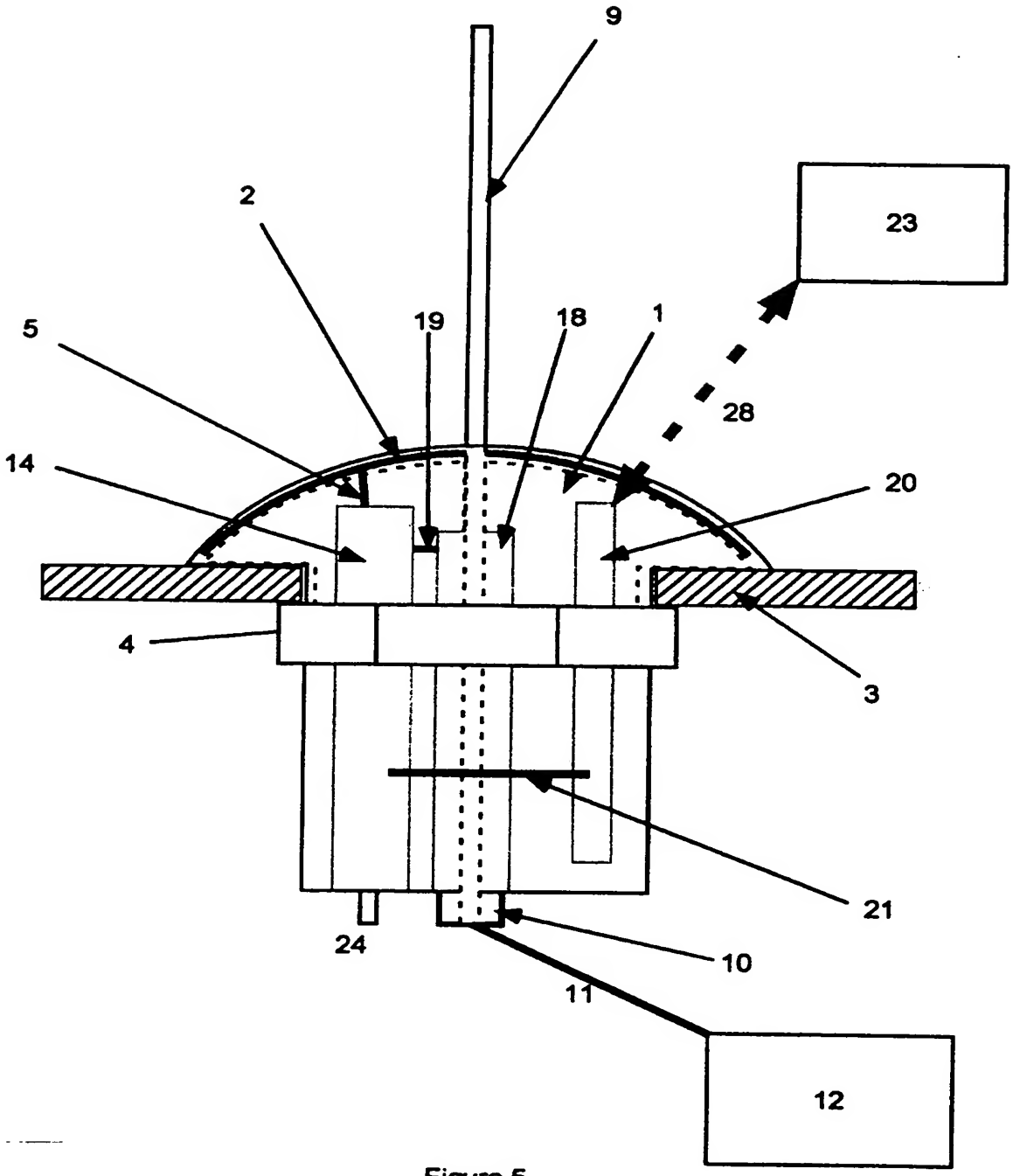


Figure 5

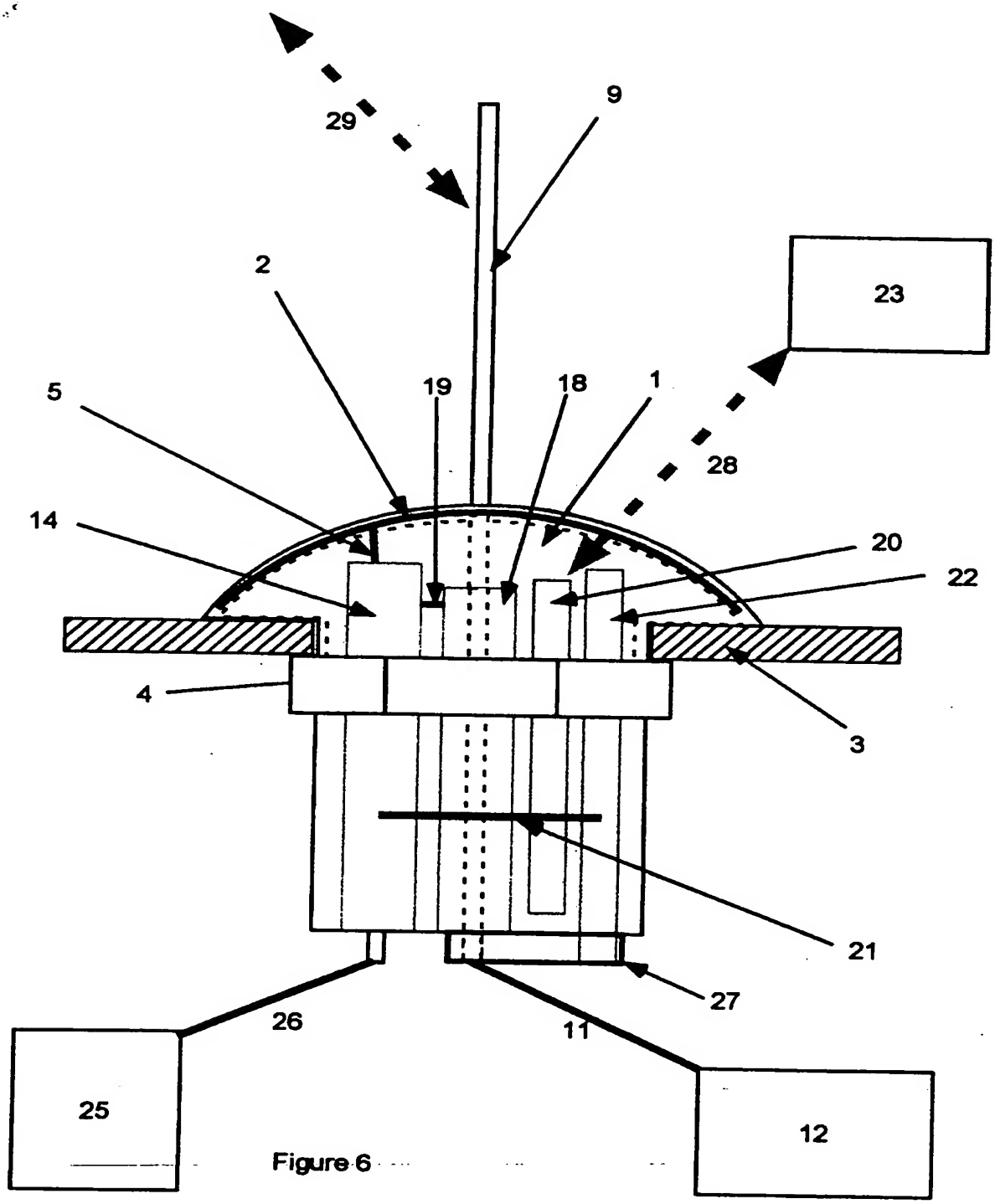


Figure 6